



July 1, 2003

Via Electronic Mail

James D. Schlichting, Deputy Chief  
Office of Engineering and Technology  
Federal Communications Commission  
445 12<sup>th</sup> Street, SW  
Washington, DC 20554

Re: ***Ex Parte* Presentation**, WT Docket No. 02-55

Dear Mr. Schlichting:

This is in response to your June 3, 2003 letter, requesting further information as discussed in the Office of Engineering and Technology's ("OET") May 29, 2003 *ex parte* meeting. You requested the assumptions and analysis underlying Nextel's (and the Consensus Parties') position that the Consensus Plan for 800 MHz Realignment (the "Consensus Plan") will greatly reduce the probability of interference to public safety communications systems as a by-product of low-site, cellular commercial mobile radio ("CMRS") operations. You also requested further information on the more than 700 incidents of interference referenced in Appendix B of Nextel's May 16, 2003 *ex parte* letter. Nextel appreciates this opportunity to respond to your letter and provides the following information.

**I. THE CONSENSUS PLAN FOR REALIGNMENT VIRTUALLY ELIMINATES INTERFERENCE TO PUBLIC SAFETY OPERATIONS**

Nextel and the Consensus Parties have consistently stated that the Consensus Plan will virtually eliminate interference from the operations of low-site CMRS operators to high-site public safety licensees in the 800 MHz band.<sup>1</sup> In its *ex parte* letter of May 16, 2003, Nextel indicated that the "Consensus Plan

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<sup>1</sup> See Nextel Comments of August 7, 2002 at pages 20-25, Nextel Comments of September 23, 2002 at pages 21-24, Consensus Plan Parties Comments of December 24, 2002 at pages 39-44, Nextel Comments of February 10, 2003 at page 9, and Consensus Plan Parties Comments of February 25, 2003 at page 20.

realignment will reduce the probability of interference to public safety licensees operating on the new NPSPAC channels by an average of 99 percent, and reduce interference to public safety (and private wireless) licensees operating at 809-814/854-859 MHz by an average of 88 percent.”<sup>2</sup>

Attachment A to this letter is a comprehensive analysis, setting forth the assumptions, methodology and analysis underlying Nextel’s probability conclusions. Attachment A compares the probability of interference in the existing interleaved spectrum environment with the post-Consensus Plan realignment environment. The analysis includes each of the following assumptions: (1) that the front-end filters of public safety receivers will “roll-off” undesired transmissions at least as well as they do today; (2) that all other performance specifications of 800 MHz public safety receivers will be at least as good as they are today; (3) that Nextel has on average 360 channels available to it today in its markets throughout channels 851-866 MHz; (4) that after realignment Nextel would have 320 channels between 861-869 MHz; (5) that the cellular A band carrier will be able to use any of its channels between 869 and 874 MHz at a given base station; and (5) that it is equally probable that Nextel and the cellular A band carrier will place in service any of their licensed channels at any given time.<sup>3</sup>

Nextel’s review of the more than 700 interference incidents reported to it indicates that while intermodulation (“IM”) continues to be the most frequently observed and dominant interference mechanism, out-of-band emissions (“OOBE”) interference is present at a level that needs to be addressed about 50 percent of the time.<sup>4</sup> Accordingly, Nextel’s probability analysis considers the incidence of both IM and OOBE in evaluating the projected interference benefits of the Consensus Plan. The analysis assumes that OOBE will be essentially eliminated through the measures proposed in Appendix F of the Consensus Plan (800 MHz realignment itself, stringent CMRS filtering made possible by separating CMRS operations and non-cellular operations into separate channel blocks, and requiring stronger signal levels for non-CMRS transmitters operating

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<sup>2</sup> See Nextel’s May 16, 2003 *ex parte* letter at page 12.

<sup>3</sup> In other words, each channel has an equal probability of being used at any given site.

<sup>4</sup> See Nextel’s May 16, 2003 *ex parte* letter at pages 13-14. As described in Section III below, Appendix C categorizes all 700 plus incidents of reported interference, including those in which IM is a factor and those in which OOBE is an interference factor. The percentage distribution is close to fifty percent for each.

closer to 861 MHz to receive interference protection).<sup>5</sup> As to IM, Nextel calculated the number of "IM" hits on 76 channels in the 854-861 MHz block and 48 channels in the existing and proposed NPSPAC block, using existing and proposed CMRS allocations between 851-874 MHz as contributors. Nextel then used the changes in IM probability along with an analysis of over 100 interference cases worked to date to determine the expected reduction in the probability of interference for the 851-861 MHz band in the post-realignment environment. Post-realignment, all public safety licensees would operate on channels in the non-cellular block below 859 MHz.

Attachment A depicts the results of this analysis on an averaged basis for each portion of the post-realignment 800 MHz spectrum band ("new NPSPAC" at 851-854 MHz, 854-859 MHz and the "Guard Band" at 859-861 MHz). Figure 1 sets forth the expected reduction in the probability of interference to public safety and private wireless operations as relocated in the proposed non-cellular band assuming that those licensees experience interference today. For example, if a NPSPAC licensee experiences interference today, the probability of that licensee experiencing interference post-realignment is reduced on average by 99 percent.<sup>6</sup> The probability of interference to a licensee in the 854-859 MHz channel block is reduced on average by 88 percent.

Due to the adjacent location of the Guard Band to the cellularized block of frequencies above 861 MHz, the probability of IM and OOB interference in the Guard Band is reduced less than it is below 859 MHz. The Consensus Plan realignment reduces the probability of interference in the 859-861 MHz "Guard Band" by an average of 65 percent. Current filter technology, however, enables most OOB to be rolled off within about one MHz of the cellular block; *i.e.*, between 860 and 861 MHz, so the 859-860 MHz portion of the Guard Band will receive close to the same OOB protection as below 859 MHz. Appendix F of the Consensus Plan calls for active management of adjacent CMRS

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<sup>5</sup> Thus, Attachment A assumes that the Consensus Plan realignment and Appendix F OOB filtering requirements eliminate OOB as a cause of CMRS – public safety interference. Nextel's analysis also assumes that Guard Band licensees meet the on-street signal strength requirements of Appendix F. The analysis does not, however, account for remaining reductions in interference enabled by realignment and required of all CMRS carriers in the post-realignment environment, as described in Appendix F.

<sup>6</sup> For example, at 851 MHz, the interference probability improvement is greater than 99 percent; at 854 MHz (the end of the relocated NPSPAC block), the improvement is 98 percent. The average reduction across the relocated three MHz NPSPAC block, rounded downward, is 99 percent.

deployments at 861 MHz using best practices-type techniques to provide the additional interference protection needed for 860 – 861 MHz licensees.<sup>7</sup> Thus Attachment A provides the analytical basis for Nextel's conclusions on the interference elimination benefits of realignment, as described in Nextel's May 16, 2003 *ex parte* letter.

## II. SWITCHABLE ATTENUATOR RECEIVER ENHANCEMENTS

In its May 6, 2003 filing, Motorola announced that it will incorporate switchable attenuators into its public safety mobile units by the end of this year and that it will produce retrofit kits to incorporate this improvement into certain legacy public safety handsets.<sup>8</sup> Motorola states that its new switchable attenuator handsets can be introduced into public safety use through the normal equipment replacement cycle, as part of the "technical toolbox" for interference mitigation in specific cases,<sup>9</sup> or through refitting legacy units on a case-by-case basis.

Figure 2 of Attachment A depicts the expected effectiveness of incorporating the switchable attenuator into public safety handsets as a complement to the Consensus Plan. As Nextel has previously stated, Motorola's announcement is a welcome additional development for reducing interference to public safety communications systems.<sup>10</sup> The uncertainty, however, concerning how rapidly and how extensively public safety operators will retrofit legacy receivers with switchable attenuators – or replace them – makes it difficult to evaluate precisely the effectiveness of this technological development. Accordingly, Nextel analyzed the probability of reduced interference from using switchable attenuator enhanced receivers in combination with the Consensus Plan assuming: (1) 25 percent of existing public safety receivers are replaced or retrofitted; and (2) 100 percent of existing public safety receivers are replaced or

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<sup>7</sup> Even without a ctive management of a djacent cellular block c hannels b y CMRS licensee(s), Guard B and licensees post-realignment will h ave far better protection from IM and OOBE interference than they have today.

<sup>8</sup> See Motorola May 6, 2003 *ex parte* letter at page 7. Motorola confirmed and further amplified its plans in its June 20, 2003 *ex parte* filing with OET.

<sup>9</sup> As discussed above, Attachment A demonstrates that if the Consensus Plan is adopted, Motorola's proposed technical toolbox will need to be used to mitigate only a limited number of post-realignment interference incidents. Appendix F of the Consensus Plan essentially incorporates technical toolbox-type measures to address such incidents in a realigned environment.

<sup>10</sup> See Nextel's May 16, 2003 *ex parte* letter at page 7.

retrofitted. Figure 2 assumes, as stated by Motorola, that the switchable attenuator will only be activated when the desired signal is stronger than -95 dBm; *i.e.*, below that level, the attenuator will reduce the desired signal below the level necessary for reliable communications. Nextel analyzed 140 interference incidents -- taking into account the incidence of both IM interference (the interference mechanism directly targeted by the switchable attenuator enhancement) as well as OOBE -- to evaluate the added benefits of switchable attenuator handsets to the Consensus Plan in eliminating CMRS -- public safety interference.

As shown in Figure 2, the *combined* impact of the Consensus Plan realignment and Motorola's receiver improvements (assuming 25 percent of public safety receivers are equipped with the new switchable attenuators) would further reduce the probability of interference, particularly in the Guard Band channels (an increase from a 65 percent reduction to about a 75 percent reduction). Incorporating the switchable attenuator in 100% of public safety receivers, in combination with Consensus Plan realignment, *would nearly eliminate interference* to both public safety and private wireless incumbents in the 800 MHz band.

- In the new NPSPAC band, overall interference (IM and OOBE) will be reduced on average by more than 99 percent.
- In the 854-859 MHz portion of the band (where the majority of public safety operations are today and where they will remain post-realignment) the combined impact reduces on average the probability of interference by 97 percent.
- Even in the 859-861 MHz "guard band", the probability of interference is reduced on average by over 90 percent from a Consensus Plan alone average of 65 percent.

As Figure 2 demonstrates, implementing the Consensus Plan will provide a substantial baseline interference improvement; the enhanced handsets -- as they are placed in service over time -- can further improve public safety communications in the 800 MHz band.

### **III. OVER 700 REPORTED INCIDENTS OF PUBLIC SAFETY INTERFERENCE DEMONSTRATE THAT CASE-BY-CASE REACTIVE APPROACHES CANNOT "SOLVE" THE INTERFERENCE PROBLEM**

Nextel's May 16, 2003 *ex parte* filing listed over 700 incidents of interference reported by public safety operators in the 800 MHz band since the

beginning of the year 2000.<sup>11</sup> Your June 3, 2003 letter requested further information identifying those incidents that required physical changes to Nextel's antennas, towers or network; the types of interference the changes were attempting to address; the specific changes that were implemented; and whether those changes resolved the interference.

#### **A. Additional Information**

Nextel's May 16, 2003 filing provided a compilation of the interference incidents reported to it as of April 30, 2003. Subsequently, (and since Nextel's May 16, 2003 filing) public safety licensees have reported additional incidents of CMRS-public safety interference. Attachment B provides an updated and detailed spreadsheet listing over 750 incidents of interference reported to and catalogued by Nextel through May 30, 2003, along with the information you requested, as explained further below.

1. The section of the spreadsheet labeled "Type of Interference" categorizes the interference experienced by the public safety licensee as follows: "IM", "OOBE", "other" (including faulty equipment, unlicensed operations, co-channel interference, spurious emissions), "incomplete data" (*i.e.*, the interference cause or causes have not or cannot be conclusively determined), and "under investigation" (the incident is being actively investigated by the CMRS carrier, the public safety licensee or both – typically these are the more recent incidents). More than one cause is involved in some incidents.
2. The next section details the changes Nextel has made to its system or operations -- in those instances where Nextel's operations are contributing to the interference – in an attempt to mitigate it on an interim basis pending a long-term reallocation solution. These include: reducing power, changing antennas, changing combiners, frequency retuning, changing antenna uptilt, and other operational or equipment modification measures (such as modifying antenna height or reducing the number of repeaters at the site).
3. The final section provides information concerning Nextel's ongoing "active management" of its operations and network necessary to maintain mitigation. For example, the spreadsheet indicates sites where Nextel is maintaining power reductions, not using certain FCC authorized channels, modifying its channel reuse plans, or

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<sup>11</sup> See Appendix B to Nextel May 16, 2003 *ex parte* letter.

reducing coverage to attempt to prevent a reoccurrence of interference. The category "unable to mitigate" includes instances where "best practices" have been ineffective to date, and those where interference is intermittent and likely involves multiple CMRS operators -- making mitigation more complex. For those instances categorized as "still under investigation," active management requirements are unknown at this time.

## **B. Analysis and Conclusions**

The information provided in Attachment B supports Nextel's (and the Consensus Parties') position that "best practices" measures are not effective means to permanent or even long-term interference solutions. Nextel has been successful in *permanently* resolving CMRS – public safety interference in only 30 of the over 700 incidents of interference listed in Attachment B (4% of all cases). Most of those cases involved atypical circumstances such as co-channel interference or a defective piece of equipment.

In approximately 25 percent of all reported incidents, Nextel (or to Nextel's knowledge any other involved CMRS carrier) has been unable to identify and therefore implement *any* temporary mitigation measure or "best practices" to reduce the interference. Another 20 percent of all instances are in active investigation today – typically the more recent occurrences.

In the remaining approximately fifty percent of the interference incidents in which Nextel's operations are involved, Nextel has been able to identify interference mitigation practices that provide temporary improvement and has implemented or is implementing them. As discussed above, however, these interference incidents are by no means resolved, but must continue to be actively managed by Nextel's engineering personnel. These practices have significant detrimental impacts on Nextel's system and its customers. Reductions in power result in lost coverage, higher dropped calls rates, increased blocked calls or lack of service in some formerly covered areas. Ultimately this approach requires a CMRS carrier to build new sites to fill in its capacity and/or coverage, which in turn raises the possibility of public safety interference in the vicinity of that site. Inefficient system operational practices and, more importantly, inefficient use of spectrum, is not a viable long-term solution to the problem of CMRS – public safety interference.<sup>12</sup>

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<sup>12</sup> Nextel has worked with cellular carriers in a number of locations to attempt to mitigate interference resulting from co-located and near-co-located CMRS base stations. These cellular operators have experienced the same detrimental impacts on their networks and their customers from "best practices" mitigation actions, making them loath to put such restraints in place. Long-term reliance on

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I trust the information contained herein is responsive to your letter of June 3, 2003. Please feel free to contact me if you have any further questions.

Respectfully submitted,

/s/ Lawrence R. Krevor

Lawrence R. Krevor  
Vice President – Government Affairs

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these measures provides only limited relief to public safety operators while degrading cellular services. The public interest requires a solution that enables all operators to make the best use of available spectrum while avoiding interference. The Consensus Plan provides that solution.



1. Introduction. Nextel has been asked to quantify the interference-reduction benefits that the Consensus Plan provides. This paper defines how the probabilities of interference reduction cited in comments filed by Nextel were arrived at and assesses the added benefit of Motorola's proposed switchable attenuator to the Consensus Plan.

2. Assumptions. The following assumptions were made in generating the probability figures:

- a. The front-end filters of 800 MHz public-safety receivers would continue to roll off at least as well as they do today (down approximately 3 dB at 874 MHz, approximately 8 dB at 880 MHz, approximately 12 dB at 884 MHz, and approximately 20 dB at 894 MHz). Based on this, an upper limit of 874 MHz was chosen for the intermodulation ("IM") probability analysis. Frequencies above this limit are attenuated more and more by the public-safety receiver itself, thereby reducing the probability that they can be involved in the formation of IM products that are sufficiently strong to interfere with desired signals in the public-safety receiver.
- b. Other performance specifications of 800 MHz public-safety receivers would at least remain as good as they are today.
- c. The probability that a given CMRS frequency used in the study will be used in the field is equal (all frequencies used have an equal probability of being involved in a post-realignment issue).
- d. In the pre-realignment environment, Nextel has on average approximately 360 frequencies available to it between 851 and 866 MHz, including all 200 of the channels between 861 and 866 MHz. In the market chosen for the study, Nextel had an actual 365 high-availability channels.
- e. In the post-realignment environment, Nextel will have available to it 320 channels from 861-869 MHz.
- f. In both the pre and post-realignment environments, the cellular-A operator would be able to use any frequency between 869 and 874 MHz. As noted above, frequencies above 874 MHz are not included in the study.

3. IM probability study. The IM probability study was conducted as follows:

3.1 Pre-realignment environment. The following steps were followed in constructing this part of the study:

- a. A contributor frequency set was constructed of Nextel and cellular-A frequencies. A Nextel frequency set of 365 channels was chosen, with 200 of those channels in the 861-866 MHz range, and the balance scattered throughout 851-861 MHz. The frequencies chosen in the 851-861 MHz range reflected the actual availability in one large Nextel market. The cellular-A frequency set was made up of all cellular channels between 869 and 874 MHz.

- b. A set of representative target frequencies throughout the 854-861 MHz and 866-869 MHz range was identified. Every channel was not examined in order to reduce processing time; however, sufficient targets were selected to provide reasonable interpolation between targets.
- c. 3<sup>rd</sup>-order IM products were calculated for all combinations of contributors for all of the target frequencies.
- d. The number of 3<sup>rd</sup>-order IM products on each target was counted, as well as the number of 3<sup>rd</sup>-order products in the entire range 851-869 MHz.

3.2 Post-realignment environment. The same methodology was followed for the post- realignment environment:

- a. The Nextel frequencies in the contributor set was made up of all frequencies between 861-869 MHz, treating the current NPSPAC channels as 25-kHz channels (as they would be in the post-realignment environment). Contributor frequencies below 861 MHz were removed. This reduced the total number of contributors from 365 to 320.
- b. The cellular-A frequencies were unchanged.
- c. The frequencies of the targets in the current NPSPAC range were translated to their proposed counterparts in the 851-854 MHz range.
- d. Target frequencies between 854-861 MHz were unchanged.

3.3 Calculation of probability changes. The number of IM products on each target in the post-realignment environment was divided by the number of IM products on the same target in the pre-realignment environment to determine the percentage increase or decrease in the number of IM products on a given target after realignment.

3.4 IM Results. Nextel's study identified the number of 3<sup>rd</sup>-order IM products falling on each NPSPAC target in the post-realignment environment as a percentage of those falling on each NPSPAC target in the pre-realignment environment and it also identified the same measurement for frequencies in the 854-861 MHz range. Nextel identified the percentage of IM products falling on each NPSPAC target in the post-realignment environment as a function of the number of IM products falling on the same targets in the current environment and made the same calculation for targets in the 854-861 MHz range. An average of the percentages was calculated for each spectrum segment analyzed (i.e. 851-854 MHz, 854-859 MHz, and 859-861 MHz).

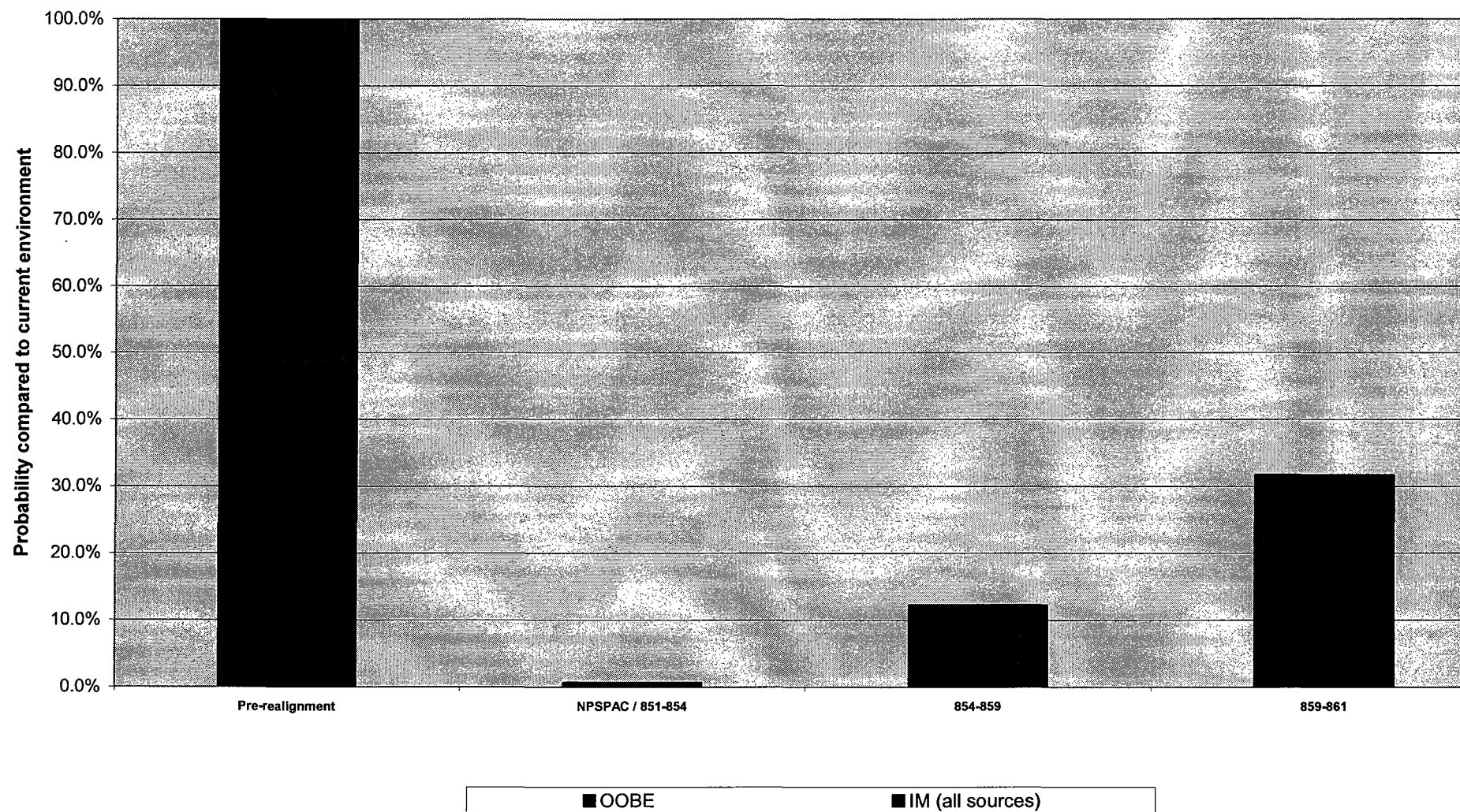
4. Analysis of OOB E. In contrast to IM-related interference, interference generated by OOB E is created solely at the offending transmitter. The requirements in Appendix F for (a) more stringent filtering of OOB E in the 851-861 MHz range and (b) increasing amounts of desired signal for non-CMRS transmitters operating closer and closer to 861 MHz in the non-CMRS allocation were

placed in Appendix F in order to make it extremely unlikely that OOBЕ would be a factor in creating interference. Assuming the requirements of Appendix F are met, OOBЕ-based interference should not occur.

5. Application of probability figures. Nextel analyzed a large sample of the reported incidents of interference to determine the root cause(s) of interference, whether it was IM-related interference, OOBЕ interference, some other mechanism, or some combination was involved in the reported incident. Of the cases, 54% had IM interference as a root cause, while 51% had OOBЕ interference as a root cause. These totals add to greater than 100% because some cases had both mechanisms in play. Nextel then applied the figures to the conditions to be expected in the post-rebanding environment (i.e. reduced probability of IM-related interference and complete removal of OOBЕ interference as an issue) to produce Figure 1. The amount of interference reduction (both IM and OOBЕ), post realignment, is significant. This analysis is based upon no active management of CMRS frequency assignments. Active management by CMRS carriers, as defined in Appendix F, will further reduce these probabilities of interference, particularly in the 859-861 MHz “guard band.”

6. Addition of Motorola switchable attenuator. Nextel did analysis on a sample of the reported incidents of IM-related interference to determine what percentage of the cases would be mitigated by the Motorola switchable attenuator alone. Based on the signal levels involved Nextel concluded that by modifying the entire base of radios approximately 74% of the IM-related cases would be resolved, leaving 26% unresolved. These figures were coupled with the results of the overall probability analysis described in 5.0 to show the additional improvement to interference probabilities that accrue from doing both rebanding and adding switchable attenuators. Figure 2 shows these improvements.

**Figure 1.**  
**Adjusted Average Post-Rebanding Probability of Interference**  
**(based on analyzed interference cases)**



**Figure 2.**  
**Comparison of Adjusted Average Probability of Interference**  
**(based on analyzed interference cases)**

